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(54) **Title:** ENTHALPY EXCHANGER

(57) **Abstract:** An enthalpy exchanger, comprising a heat-conducting wall along both sides of which two respective media can flow in mutual enthalpy-exchanging contact, which wall is provided with a hydrophilic cover layer with at least the following properties: (a) a strong adhesion; (b) a substantially complete covering; (c) a maximum thickness of 50 μm; (d) a heat resistance which is small relative to the total heat resistance; (e) a moisture absorption capacity such that water absorbed during wetting spreads as a film over the cover layer; (f) little surface roughness; (g) little susceptibility to degradation, erosion, growth of micro-organisms and adhesion of dirt; (h) morphological, chemical and physical uniformity; which cover layer is applied by chemical means by first activating each relevant surface and subsequently forming the cover layer by chemical reaction from an aqueous solution.

ENTHALPY EXCHANGER

The invention relates to an enthalpy exchanger, comprising a heat-conducting wall which is optionally provided with surface area-enlarging means such as fins or the like, and along both sides of which two respective media can flow in mutual enthalpy-exchanging contact, which wall and/or which surface area-enlarging means are provided with a hydrophilic cover layer.

Such an enthalpy exchanger is known.

Use is made for the cover layer of organic materials, inorganic materials, synthetic materials in the form of monomers and/or polymers, ceramic materials, metallic materials and hybrid materials. In the prior art the morphology of the cover layers, i.e. the internal microstructure and macrostructure, is continuous, discrete (particles), optionally with a binder, with capillary interstitial spaces for absorbing water, hygroscopic, hydrophilic, hydrophobic, varying thicknesses, a woven or non-woven material, filamentary materials.

The cover layer can fulfil one or more of the following functions: protecting against corrosion and/or erosion of each relevant surface; improvement of the thermal resistance; improvement of the appearance; improvement of impact resistance, for instance susceptibility to degradation as a result of loose chippings; improvement of the chemical and/or biochemical resistance of each relevant surface; changing frictional resistance and/or flow resistance; moisture absorption and/or evaporation.

In the prior art undesirable and uncontrollable side effects cannot be avoided. These are particularly an uncontrolled increase in thermal resistance, which is important in respect of the necessary heat transfer, the vulnerability to erosion and corrosion, susceptibility to diverse forms of degradation, inadequate adhesion, whereby the lifespan is not all it might be,

susceptibility to growth of micro-organisms, susceptibility to accretion of dirt.

In addition, existing layers, even with a limited controllability of desired properties, can only be applied by relatively costly production processes.

The prior art does not provide cover layers which are suitable for different types of enthalpy exchangers and which have controllable and homogeneous properties.

It is an object of the invention to provide an enthalpy exchanger which does meet required standards.

In this respect the invention provides an enthalpy exchanger, comprising a heat-conducting wall which is optionally provided with surface area-enlarging means such as fins or the like, and along both sides of which two respective media can flow in mutual enthalpy-exchanging contact, which wall and/or which surface area-enlarging means are provided with a hydrophilic cover layer with at least the following properties:

(a) a strong adhesion to each relevant surface;

(b) a substantially complete covering of each relevant surface;

(c) a maximum thickness of 50 µm;

(d) a heat resistance which is small relative to the total heat resistance in the enthalpy transfer path between the relevant surface and the flowing medium;

(e) a moisture absorption capacity such that water absorbed during wetting spreads as a film over the cover layer, optionally in combination with the formation of a buffer supply of water which is absorbed in the cover layer by capillary action;

(f) little surface roughness such that flowing medium encounters only a negligible flow resistance;

(g) little susceptibility to thermal, chemical and biochemical degradation, erosion, growth of micro-organisms and adhesion of dirt;

(h) morphological, chemical and physical uniformity;

which cover layer is applied by chemical means by first activating each relevant surface physically, chemically and/or mechanically and subsequently forming

the cover layer by a chemical reaction from an aqueous solution.

A specific embodiment has the special feature that the cover layer contains portland cement with micro-grain, wherein water storage and water transport is possible with little resistance in the interstitial spaces.

In this latter embodiment the enthalpy exchanger can have the special feature that the activation of each relevant surface during production has taken place by degreasing, mechanical blasting, etching and/or priming. The cover layer can meet set requirements. Use can be made for this purpose of said activation. The layer thickness can further be controlled for instance by electrostatic metering and application, reducing the grain size, controlling the moisture balance during curing and thermal regulation of the curing speed. Regulation of the capillary structure and the possibility of moisture storage can further be realized by controlling the grain size.

Yet another enthalpy exchanger according to the invention has the special feature that the cover layer consists of organic material.

This variant can for instance have the feature that the material contains an acryl and/or an amide.

This enthalpy exchanger can meet set requirements if the following measures are taken:

- Choosing and adjusting the hydrophilic properties of the cover layer, which can be determined for instance by choosing the ratio of acryl and amide. Account has to be taken here of the generally hydrophilic character of acryl, while an amide is generally not particularly hydrophilic unless it is modified.

- Activating each relevant surface during production by exposure to a plasma.

- Improving the thermal resistance by selection of basic monomer and polymer groups, chain lengths and the like in relation to the curing process.

- Improving the formation of a water film by increasing the content of hydrophilic additives.

- Improving the resistance to micro-organisms by increasing molecule chain lengths.

In yet another embodiment the enthalpy exchanger has the special feature that the cover layer consists of a silicate, for instance a sodium silicate or a potassium silicate.

This embodiment can have the special feature that the activation of each relevant surface during production has taken place by exposure to a plasma, degreasing, etching, anodizing and/or mechanical blasting.

An enthalpy exchanger of this latter type can meet set requirements by applying the following measures:

- Choosing and adjusting the hydrophilic properties of the cover layer for water film formation by adjusting the solution strength of silicon dioxide and thereby adjusting the layer thickness (from several µm to in the order of 20-40 µm);

- The thermal resistance of such a cover layer is excellent and generally requires no special attention;

- Improving the water film formation by increasing the content of hydrophilic additives (for instance metal salts which can bind moisture in the form of crystallization water);

- As a result of the chemical composition the resistance of this layer to micro-organisms is already excellent and requires no further special attention;

- The adhesion of the cover layer to each relevant surface can be excellent in an embodiment wherein the activation of each relevant surface during production has taken place by exposure to a plasma, degreasing, etching, anodizing and/or mechanical blasting.

The silicate cover layer is suitable for applying to surfaces of the most diverse materials, for instance metals, ceramic materials and plastic, in particular PVC. In the case stainless steel is used, the activation of the surface can take place by etching with sulphuric acid and chromic acid, followed by rinsing and drying. In the case of copper, etching can take place effectively by making use of sulphuric acid followed by rinsing and drying. The cover layer is then applied from

an aqueous solution of sodium hydroxide or potassium hydroxide with silicon dioxide.

It will be apparent from the foregoing that the invention provides an enthalpy exchanger with a cover layer, the properties of which can be very well controlled for the most diverse applications and designs of the enthalpy exchanger.

CLAIMS

1. Enthalpy exchanger, comprising a heat-conducting wall which is optionally provided with surface area-enlarging means such as fins or the like, and along both sides of which two respective media can flow in mutual enthalpy-exchanging contact, which wall and/or which surface area-enlarging means are provided with a hydrophilic cover layer with at least the following properties:

(a) a strong adhesion to each relevant surface;

(b) a substantially complete covering of each relevant surface;

(c) a maximum thickness of 50 μm;

(d) a heat resistance which is small relative to the total heat resistance in the enthalpy transfer path between the relevant surface and the flowing medium;

(e) a moisture absorption capacity such that water absorbed during wetting spreads as a film over the cover layer, optionally in combination with the formation of a buffer supply of water which is absorbed in the cover layer by capillary action;

(f) little surface roughness such that flowing medium encounters only a negligible flow resistance;

(g) little susceptibility to thermal, chemical and biochemical degradation, erosion, growth of micro-organisms and adhesion of dirt;

(h) morphological, chemical and physical uniformity;

which cover layer is applied by chemical means by first activating each relevant surface physically, chemically and/or mechanically and subsequently forming the cover layer by a chemical reaction from an aqueous solution.

2. Enthalpy exchanger as claimed in claim 1, wherein the cover layer contains portland cement with micro-grain, wherein water storage and water transport

is possible with little resistance in the interstitial spaces.

3. Enthalpy exchanger as claimed in claim 2, wherein the activation of each relevant surface during production has taken place by degreasing, mechanical blasting, etching and/or priming.

4. Enthalpy exchanger as claimed in claim 1, wherein the cover layer consists of organic material.

5. Enthalpy exchanger as claimed in claim 4, wherein the material contains an acryl and/or an amide.

6. Enthalpy exchanger as claimed in claim 5, wherein the activation of each relevant surface during production has taken place by exposure to a plasma.

7. Enthalpy exchanger as claimed in claim 1, wherein the cover layer consists of a silicate, for instance a sodium silicate or a potassium silicate.

8. Enthalpy exchanger as claimed in claim 7, wherein the activation of each relevant surface during production has taken place by exposure to a plasma, degreasing, etching, anodizing and/or mechanical blasting.

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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F24F B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Name and mailing address of the ISA	Authorized officer
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